A PHYLLOCARID CRUSTACEAN, *ECHINOCARIS AURICULA*, FROM THE LATE DEVONIAN OF WEST VIRGINIA

JOSEPH T. HANNIBAL

Cleveland Museum of Natural History
Wade Oval
University Circle, Cleveland, Ohio 44106

and

RODNEY M. FELDMANN

Department of Geology
Kent State University
Kent, Ohio 44242

Abstract

A phyllocarid crustacean, *Echinocaris auricula* Eller, is reported from Upper Devonian Chemung rocks in Preston County, West Virginia. The species was originally based upon a single carapace valve from New York state. The specimen from West Virginia is preserved with both valves, the entire abdomen, and much of the telson present. It differs from the holotype in details of ornamentation of the carinae, in the development of the anterior ventral tubercle on the anterodorsal node of the carapace, and in other features. These differences are due to intraspecific variation.

Introduction

Echinocaris is a Paleozoic phyllocarid crustacean. The genus was named by Whitfield in 1880 for specimens collected from the Chagrin Shale in Ohio. To date, 18 species of *Echinocaris* have been formally named from the Paleozoic of North America. Additionally, at least nine specimens, or groups of specimens, have been referred to as *Echinocaris* sp. Although specimens have been referred to the genus from a number of localities around the world, including the Soviet Union, Burma, New Zealand, and Great Britain, the preponderance of species are North American. Of the North American forms, eight have been identified from northeastern Ohio, nine are known from western New York state, and at least six have been identified from Pennsylvania. Several of these forms have been reported from more than one state. The identity of species reported in early literature cannot be confirmed solely by examination of the original works because some of the papers either lacked illustrations or were inadequately illustrated. Only one reference has been made to a form from West Virginia.

Woodward, in his *Devonian System of West Virginia* (1943) provided checklists of Devonian taxa reported from portions of the Appalachian region, including West Virginia and adjacent areas. His list of mid-Devonian taxa from the north-central Appalachian region included *Echinocaris punctata* (1943:366), but this occurrence was noted to be outside West Virginia. No echinocaridids appear on his early or late Devonian faunal lists. However, Williams and Kindle (1905:37, chart facing p. 55) reported the rare occurrence of *Echinocaris* sp. in a faunule near White Sulphur Springs in southeastern West Virginia. They did not identify the presence of *Echinocaris* in any of the other assemblages they studied in the Devonian of the middle Appalachians.

A single specimen (CMNH 3804) from West Virginia is deposited in the Cleveland Museum of Natural History. It conforms closely to Eller's sketch of *Echinocaris auricula* (1935: Pl. III, Fig. 7) and is more completely preserved, having both valves, the entire abdomen, and much of the telson present. The Cleveland Museum specimen was collected by Dr. James Helwig and a group of students from Case Western Reserve University, on March 21, 1972, from a road cut on the west side of West Virginia State Route 72, on the west bank of the Cheat River. This locality (see Fig. 1) is approximately 2 km (1.3 mi) north of U.S. Route 50 and is south of the town of Rowlesburg, Preston County, West Virginia (Rowlesburg 7-1/2 minute Topographic Quadrangle).

Stratigraphic Setting

The rocks at the West Virginia locality consist primarily of medium grey and dark grey shales, silty shales, grey siltstones, and light-colored thin- to thick-bedded sandstones. Thicker sandstone beds are often crossbedded and some sandstone beds have channel-like concave bottoms. The precise horizon in which the echinocaridid was found is not known with certainty, but it was probably found in one of two shale and siltstone layers, about 1.3 to 1.5 m thick, located along the highway in the area marked on Figure 1. The echinocaridid is preserved on a small piece

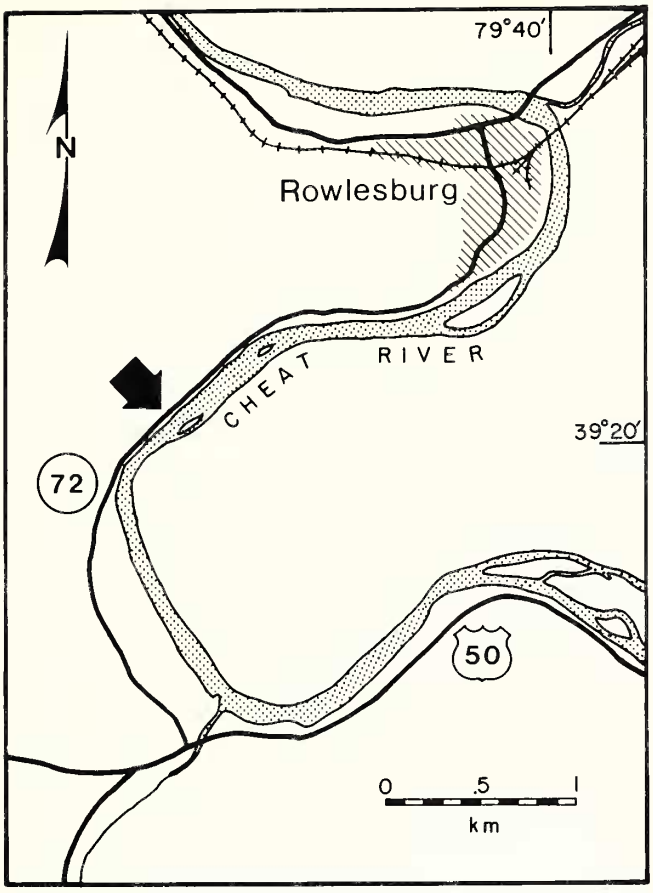


Fig. 1. Location map showing the site, indicated by arrow, in Preston County, West Virginia, from which *Echinocaris auricula* was collected. Only major features are shown.

of dark grey shale that generally conforms in lithology with some of the shales in these two layers. Invertebrate body fossils are sparse in the shaley and silty layers, but linguloid brachiopods and some other invertebrates are present. Trace fossils and plant fragments, however, are common at the locality, primarily in the siltier and sandier beds.

The rocks at the locality are currently mapped (Cardwell et al. 1968) as being part of the Chemung Group. Hennen and Reger (1914:97–101) published a detailed description of a geologic section made in the vicinity of this locality. They show 751 ft of rocks in the Chemung Series as being exposed along a four-mile transect between Anderson and Rowlesburg, extending to the Cheat River. However, since the term "Chemung" is no longer used for mapping rocks in the type area in New York state, the stratigraphy of the area is being revised by some geologists, most actively by Dennison (1971). The rocks in the immediate vicinity of the new locality have yet to be remapped using newer formation names.

Eller (1935:263) proposed the name Alfred Shale for the fossiliferous shale in which *Echinocaris auricula* was originally found and the overlying siliceous shale in the vicinity of Alfred Station, Allegany County, New York. Eller later noted (1937:257) that the Alfred Shale was a local facies of the Gowanda Shale, of the Canadaway Group. Cooper et al. (1942: chart no. 4) correlated the Alfred Shale with the Caneadea Shale of the Canadaway Group, but Manspeizer (1963) did not mention the Alfred Shale in his restudy of the Chautauquan Series of Allegany County. The rocks at Alfred Station are currently mapped (Rickard and Fisher 1970) as being in the Canadaway Group (which includes the Caneadea Shale and other units).

Both the "Chemung" rocks of the West Virginia locality and the Canadaway Group rocks of the New York locality are Late Devonian in age. Rickard (1975: Pl. III) placed most of the Canadaway Group, including the Caneadea Shale and the Gowanda Shale, tentatively within the Famennian.

Systematic Paleontology

Subphylum Crustacea Pennant, 1777
Class Malacostraca Latreille, 1806
Subclass Phyllocarida Packard, 1879
Order Archaeostraca Claus, 1888
Family Echinocarididae Clarke *in* Zittel, 1900
Genus *Echinocaris* Whitfield, 1880
Echinocaris auricula Eller, 1935
Figures 2,3

Echinocaris auricula Eller 1935:271, Pl. III, Fig. 7; Copeland 1960:3, 4; Sturgeon, Hlavin and Kesling, 1964:53.

Material studied

Holotype, Carnegie Museum, CM 7228, and its counterpart, CM 7292; Cleveland Museum of Natural History, CMNH 3804.

Description of material

Carapace small for genus, length measured parallel to hinge line about 10 mm. Outline of each valve of carapace subovoid, truncate anteriorly, posterior extended with greatest distance from hinge to outer margin posteriorad the midline. Length to width ratio approximately 5 to 3.

Hinge line located toward anterior, short, straight, about 60% length of the carapace. Well-defined, typically keeled, marginal ridge surrounds carapace on remaining sides. Anterior of this ridge with three to four small tubercles developed on axis of keel. Posterodorsal and posterior portion of ridge with about six small, evenly spaced tubercles on outer face of marginal ridge distributed from the hinge line to the area just behind the posterior termination of centroventral ridge. Marginal sulcus located interior of marginal ridge except between posterodorsal ridge and hinge.

Centroventral ridge gently sigmoidal, long, extending about 60% the length of carapace; anterior smooth, pos-

terior smooth (CM 7228) or with weak swellings (CMNH 3804). Posterocentral ridge long, gently convex dorsally (CM 7292) or nearly straight (CMNH 3804), strongly tuberculate (CM 7228) or nearly smooth (CMNH 3804). Posterodorsal ridge straight, located approximately midway between hinge line and posterocentral ridge, intercepting marginal ridge posteriorly; with single tubercle (CM 7228) or relatively smooth (CMNH 3804). This ridge extends anteriorly approximately as far as posterocentral ridge, to within about 0.5 mm of the posterodorsal lobe (CMNH 3804), or can be considerably shorter (CM 7228).

Anterodorsal lobe large, subtriangular, irregularly convex, with a dorsal tubercle and a pair of ventral tubercles, the anterior of which may be small (CM 7228) or elongated into a ridge and flanked laterally by a low, sinuous ridge (CMNH 3804). Dorsal lobe subtriangular, gently convex, with a low relief, and with centrally located tubercle. Posterodorsal lobe subovate, dorso-ventrally elongate, strongly and smoothly convex, with tubercle located toward dorsal margin. Centroventral lobe subovate, obliquely elongate, strongly and smoothly convex, with median tubercle.

Sulci defining major lobes well defined. Most of surface of carapace finely to very finely pitted, distinctly on dorsal lobe and on the posterior region of the posterior lobe.

Abdominal segments crushed, poorly defined. Segments appear to increase in length posteriorly; no distinct abdominal spines evident; distinct median dorsal ridge and less distinct ridges flanking it, all of which could be artifacts of crushing. Telson head globose, lateral and axial telson spines long and slender.

Preservation

The holotype, CM 7228, eonsists of a single valve which does not appear to have been crushed or distorted. The integument is in place and unfractured over virtually the entire specimen. The counterpart of the holotype, a mold of the exterior of the single valve, shows no other remains and is catalogued separately as CM 7292. The West Virginia specimen, CMNH 3804, is considerably flattened, slightly distorted, and with only a small amount of the original curvature of the valves preserved. The abdomen is crushed, flattened, and recognition of articulations and

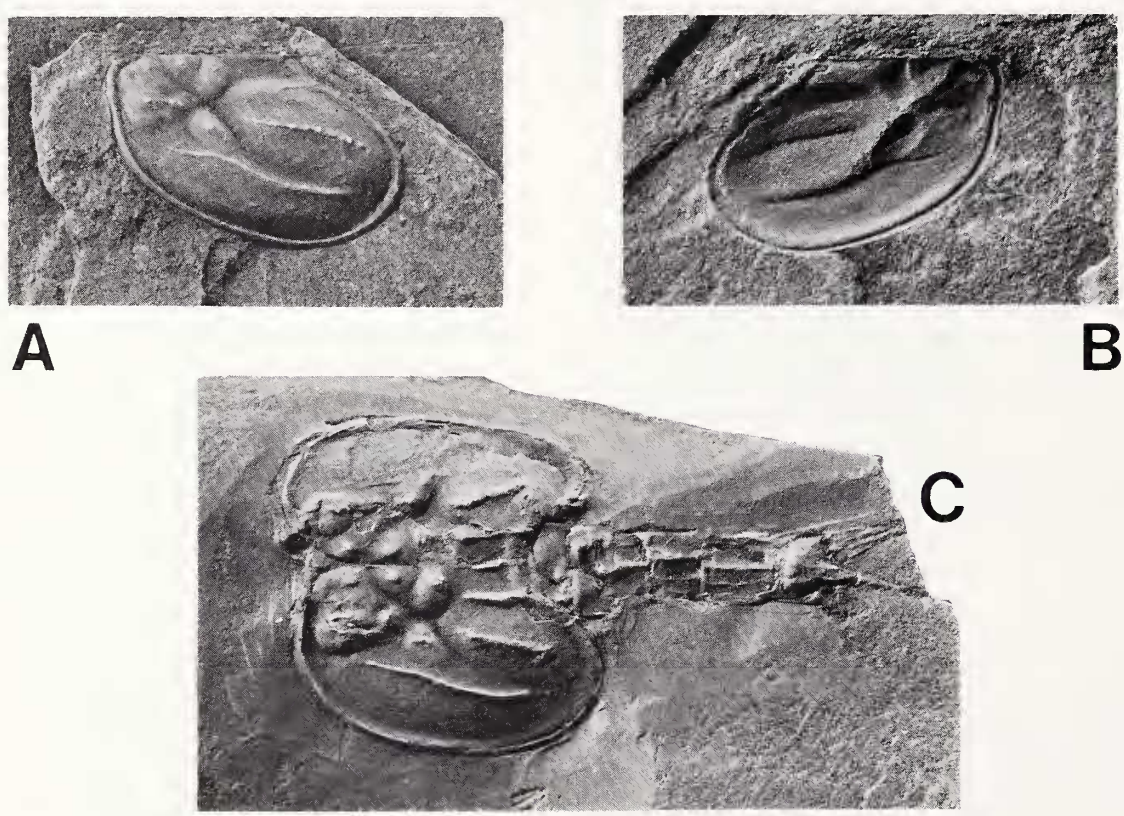
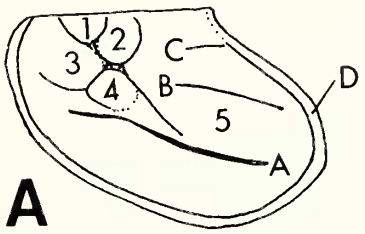


Fig. 2. *Echinocaris auricula* Eller, 1935. *A,* Holotype, CM 7228, a complete and undistorted left carapace half showing the three posterior ridges diagnostic of the species and the alate posteroventral area, × 4. *B,* Counterpart of the holotype, CM 7292, × 4. *C,* CMNH 3804, a complete but slightly crushed and distorted carapace and complete but crushed abdomen and telson. This specimen shows carapace morphology comparable to that of the holotype.



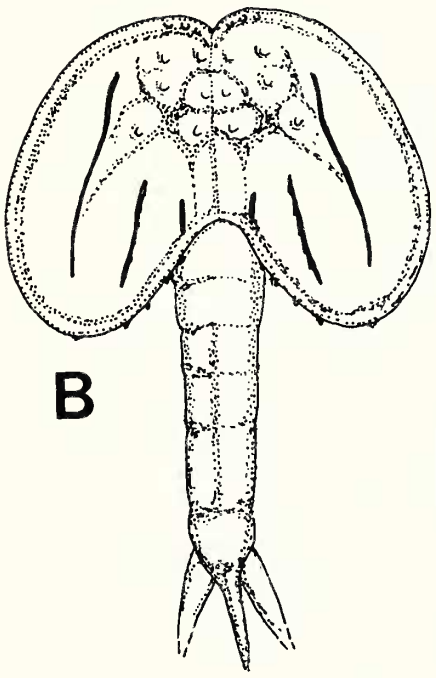


Fig. 3. *A*, Outline drawing of the left half of the carapace of *Echinocaris auricula* showing the location and terminology applied to key features on the carapace. 1, dorsal lobe; 2, posterodorsal lobe; 3, anterodorsal lobe; 4, centroventral lobe; 5, posterior lobe; A, centroventral ridge; B, posterocentral ridge; C, posterodorsal ridge; and D, marginal ridge. *B*, Composite sketch of the entire carapace and abdomen of *E. auricula* interpreted from the holotype and the specimen from West Virginia. Although the relative position and degree of development of parts on the carapace is generally accurate, the details of all but the gross general proportions of the abdomen are approximate as a result of crushing and distortion of the sole specimen.

original ornamentation is difficult. The integument is preserved over most of the specimen, with the major exception of large portions of the right valve of the carapace. Also, in places the integument is cracked or crushed.

Measurements

Measurements, in mm, taken on the two specimens are given below. The measurements taken on the holotype, CM 7228, are given first and are in parentheses. The second measurements, not in parentheses, are taken on CMNH 3804. Carapace length, (9.9) 10.7; carapace height, (6.2) 6.0; hinge length (5.2) 6.5; centroventral ridge length (6.4) 5.6; posterocentral ridge length (approx. 1.6) 2.1; abdomen length, excluding telson, 8.3; abdomen maximum width, 3.1; abdomen minimum width, 2.0; telson length, >3.6; axial telson spine length, >>2.6.

Remarks

Eller (1935) based the species *Echinocaris auricula* on a well-preserved left valve from the Upper Devonian "Chemung" Shale at Alfred Station, in southwestern New York state. This species has not previously been photographically illustrated. The West Virginia specimen conforms closely to Eller's specimen and his description and sketch. Because the species is readily distinguishable from all others, there can be little doubt of its placement.

The general outline of *E. auricula* is different from that of other members of the genus, particularly because of the pronounced anterior position of the hinge and concomitant prolongation of the posterior of the carapace. Additionally, it is one of only two species that possesses three carinae on the carapace. The most closely related species is *E. castorensis* Copeland, 1960, reported from the upper Devonian rocks of the Alexo Formation, Alberta, Canada. This species, as reconstructed by Copeland (1960: Fig. 1), is also characterized by the development of three carinae. Upon examining the type material we have been able to discern the centroventral ridge and the posterodorsal ridge on these specimens, but have been able to discern only a suggestion of a very short posterocentral ridge. By contrast, all three ridges are well developed and distinct on *E. auricula*. The nodes on the carapace of *E. auricula* are generally similar to those of *E. castorensis*. The most notable difference in the nodes of these two species is the presence of a tubercle on the centroventral lobe of *E. auricula* and the lack of such a feature on the corresponding lobe of *E. castorensis*. The general outline of *E. castorensis* is also different than that of *E. auricula*, being less alate and having a more centrally located hinge.

Relatively few species of the genus in addition to *E. auricula* and *E. castorensis* have a posterocentral ridge. These include: *E. pulchra* Sturgeon, Hlavin, and Kesling, 1964; *E. randalli* Beecher, 1902; *E. socialis* Beecher, 1884; and *E. whidbornei* Jones and Woodward, 1889. Among these, however, there are also other differences, such as the degree of development of lobes, presence or absence of tubercles, and shape of the hinge that serve to distinguish these species from *E. auricula*.

The above redescription allows for some intraspecific variation, especially in regard to the development of tubercles on the anterodorsal node and the exact nature of the carinae. Since Eller based the species *E. auricula* on a single specimen, he could not discuss variation and, in fact, little has been done regarding intraspecific variation

among members of the genus. It is certainly clear that some variation must, indeed, have existed and the development of minor tubercles and minute elements of ornamentation on the carapace must be taken as well within the range of individual variation.

Discovery and identification of this second specimen of *E. auricula* lends credence to the validity of the taxon. Ridges, grooves, carinae, and related structures on delicate arthropod skeletons are often the result of distortion during preservation. Very often it is difficult or impossible to distinguish between actual ridged structures and artifacts of preservation. Further, different surface structures can often be discerned, depending upon the degree of exfoliation of the exoskeleton. The discovery of a second specimen conforming very closely to the morphology of the holotype not only reinforces the original description but also confirms that the structures described were structures actually present on the living organism. Additionally, the West Virginia specimen provides a view of the abdomen and telson. Unfortunately, both are crushed substantially and very little can be said about the morphology of this region except that it seems to be more or less like that seen in better preserved specimens of some other *Echinocaris* species, notably *E. punctata.*

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